In this activity, students follow steps similar to those in the Lesson 4.1 Example. TI-Navigator allows students to move their own coordinate point in real time to explore slope triangles. The activity concludes with several Quick Poll questions that help you evaluate student understanding.

Activity Time: 40–50 minutes

PREREQUISITES AND MATERIALS

You will need the TI-Navigator activity files **4-1 Slope Triangle.act** and **4-1 Slope Exploration.act.**

SETTING UP THE ACTIVITY

On the TI-Navigator teacher computer home screen, click the *Activity Center* icon. Then choose **File | Load | Load Activity Settings** and load the activity settings file **4-1 Slope Triangle.act.**

RUNNING THE ACTIVITY

Have students do the Points and Slope investigation. When they are finished, begin this activity.

For help logging in, see the Tip Sheet.

1. Go to the TI-Navigator home screen and click the **Begin Class** button. Ask students to log in on their calculators and go to the Activity Center.

In this activity's settings your students have a Step Size of 0.5. That is, their cursors move 0.5 unit every time they press an arrow key on their calculators.

2. Go to the Activity Center and click the **Start Activity** button. Students will see a picture of a coordinate grid with a line segment and two points. Explain to students that they have control over a point in the plane. As students move their points, you'll see the points spread out over the plane. Let them explore how their points move, then click the **Pause Activity** button.
3. Select **View | Individualize Student Cursors.** This will replace the generic cursors with icons that are unique for each student. (If there is a check next to this option in the pull-down menu, it is already selected.) You may also wish to select **View | Show Student Names.** Then, when you position your mouse over a cursor, you will see the coordinates of the cursor and the Display Name of the student to whom it belongs. Be conscious, though, about allowing students the freedom to explore anonymously. Click **Resume Activity.**
4. Instruct students to move to the point (1, 7). Once every individual cursor is at (1, 7), click **Pause Activity.** Tell students that when you resume the activity, they will move to the point (6, 4) by following the orange arrows, and they'll count

how many units they move horizontally and vertically. (*Note:* The cursors move in increments of 0.5 unit, so observe carefully to ensure that students count properly.) Click **Resume Activity,** and allow students to move and count the lengths. Once all the students have their cursors in place at the coordinate (6, 4), click **Pause Activity.** (*Note:* Students will be tempted to not follow the arrows, so you may have to make a couple of attempts by pausing and resuming the activity with the students going back to their original position.)

For help with Quick Polls, see the Tip Sheet.

Q1 Ask students to use their horizontal and vertical distances to calculate the slope between the points (1, 7) and (6, 4). Do a Quick Poll set to "Open Response" and have students submit their slopes with a "+" sign to indicate moving right and a "−" sign to indicate moving down. (For example, down 10 and right 4 would be "−10/+4.") Discuss any unusual results and emphasize the use of the positive and negative signs for direction. When you are done with the Quick Poll, close the window.

5. Tell students that they'll now move from (6, 4) to (1, 7) following the purple arrows, and calculate the slope. Click **Resume Activity,** and have students move between the points and calculate the horizontal and vertical distances.

Q2 Again, have students use their horizontal and vertical distances to calculate the slope between the points. Do a Quick Poll set to "Open Response" and have students submit their slopes with a "+" sign to indicate moving up and a "−" sign to indicate moving left. Again, discuss any unusual results and discuss how the slope values have reversed + and − signs, due to following the orange arrows rather than the purple arrows.

Q3 Discuss whether the slope of the line is different if the slope is represented by +3/−5 or −3/+5.

6. You may want to introduce the slope formula at this time and discuss the change in y-values and the change in x-values between the starting and ending points.

Now students will further practice calculating slope using slope triangles.

7. Select **Edit | Clear Activity Data.** Choose **File | Load | Load Activity Settings** and load the activity settings file **4-1 Slope Exploration.act.** Click **Start Activity.** Display several lines and have students move along a slope triangle to find the slopes. To do this, first cover the projector display so the students cannot see the lines that you are entering. Click the **Graph-Equation** tab. On the right side of the screen, enter equations into the Y= box and click **Add.** A green line will appear for each equation you add. You might use equations such as $y = 2x$, $y = 1/3x$, $y = -4x + 4$, and $y = 0.5x + 2$. You can graph all the lines at once and have the students graph them on paper and move their cursors on the screen to trace the slope triangles

for each equation, or you can do one equation at a time. Click the **Graph** tab. Do a Quick Poll set to "Open Response" and have students submit their slopes with a "+" sign to indicate moving up or right and a "−" sign to indicate moving left or down. You can continue with other equations until you think the students have a good feel for slope triangles.

In the remainder of this activity, students will discover what lines with positive, negative, zero, and undefined slopes look like. Be sure to select **Edit | Clear Activity Data** now and after each of steps 8 through 14. You may also wish to click **Pause Activity** after each of these steps, then click **Resume Activity** when you're ready to continue.

8. To investigate positive slope, have students move their cursors and form a line with slope 1 that passes through the origin. Remind them that they cannot share the same point with anybody else in the class. It will take a while for students to organize themselves as a class. Once they have formed the line, discuss what they notice about the x- and y-values. Do a Quick Poll set to "Open Response" to have students submit the equation of the line. Click the **Graph-Equation** tab, enter the equation $y = x$ in the Y= box, and click **Add** to graph it. Click the **Graph** tab.
9. Next, have students form a line passing through the origin, with slope $\frac{1}{4}$. Once they have formed the line, do a Quick Poll set to "Open Response" and ask students to submit the equation of the line. Click the **Graph-Equation** tab, enter the equation $y = \frac{1}{4}x$ into the Y= box, and click **Add.** Discuss the steepness of the line compared to the line $y = x$.
10. Next, have students form a line passing through the origin, with slope 4 (the slope triangle will go up 4 units and over 1 unit). Once they have formed the line, do a Quick Poll set to "Open Response" and ask students to submit the equation of the line. Click the **Graph-Equation** tab, enter the equation $y = 4x$ into the Y= box, and click **Add.** Discuss the steepness of the line compared to the lines $y = x$ and $y = \frac{1}{4}x$.
11. Have students graph the three equations $y = x$, $y = \frac{1}{4}x$, and $y = 4x$ on graph paper, drawing the slope triangle for each equation.
12. To investigate negative slope, instruct students to form a line passing through the origin, in which the y-value of their point is the opposite of their x-value. Do a Quick Poll set to "Open Response" and ask students to submit the equation of the line. Have students graph other lines with negative slope, such as $y = -\frac{1}{3}x$ and $y = -3x$, until you feel that they are comfortable with comparing slopes of negative lines.

13. To investigate zero slope, instruct students to form a line for which the y-values are all 3 (that is, a horizontal line that passes through $(0, 3)$), in which the change in y is 0 but the change in x can be any number.

14. To investigate undefined slope, instruct students to form a line for which the x-values are all -4 (that is, a vertical line that passes through $(-4, 1)$), in which the change in y is any number but the change in x is 0.

Q4 Do Quick Polls set to "True False" and have students respond either "True" or "False" to the following statements. (*Note:* Either cover the projection device or move the Quick Poll window down so students cannot see each other's responses as they come in.) Discuss student responses and review concepts as needed.

- A line that goes up from left to right has a positive slope. [True.]
- A horizontal line has undefined slope. [False.]
- A line that is vertical through the x-axis has undefined slope. [True.]
- A line that goes down from left to right has negative slope. [True.]

Q5 Do Quick Polls set to "Open Response" and have students respond to the following questions. Discuss student responses and review concepts as needed.

- What is the slope of the line that passes through $(2, 4)$ and $(4, 6)$? [1]
- What is the slope of the line that passes through $(5, -3)$ and $(-2, -5)$? [2/7]

In this activity sequence, students follow steps similar to those in the Beam Strength investigation. TI-Navigator allows students to share their data easily and see equations that classmates use to fit the data gathered. This activity also includes Quick Poll questions and Screen Captures to evaluate student understanding.

For help with Screen Captures and Quick Polls, see the Tip Sheets.

There are many possible options in doing this investigation. One option is to follow all of the steps as they are in the book and do Screen Captures as students work through the investigation. The Screen Captures will give you a sense of how students are progressing. Another option is to ask Quick Poll questions as students work through the investigation. A third possibility is to have students report out their groups' findings. The last option is described in this activity.

Activity Time: 40–50 minutes

PREREQUISITES AND MATERIALS

You will need the TI-Navigator activity file **4-2 Beam Strength.act** and the materials listed in the Teacher's Edition for the Beam Strength investigation.

SETTING UP THE ACTIVITY

On the TI-Navigator teacher computer home screen, click the *Activity Center* icon. Choose **File | Load | Load Activity Settings** and load the activity settings file **4-2 Beam Strength.act.**

Click the **Graph** tab within the Activity Center.

RUNNING THE ACTIVITY

1. Have students work through Steps 1–12 of the Beam Strength investigation. Students should enter *Strands of Spaghetti* into L1 and *Maximum Load* into L2.
2. When students are almost done with the investigation, prepare for groups to report their findings. To do this, click the **Begin Class** button on the TI-Navigator home screen.

For help logging in, see the Tip Sheet.

3. Assign one student per group to be the group reporter, who will submit the group's lists and equations. Instruct the reporters to log in and go to the Activity Center. Click the *Activity Center* icon and click **Start Activity.** Reporters will see their lists L1 and L2 on their calculators. Ask them to press SEND (Y=). The Activity Center will display the data.
4. Once reporters have sent their data, click the *Zoom Stat* icon (at the far right end of the Activity Center toolbar) to see all the data. Click **Stop Activity.**

5. Every group's data will be displayed on the screen. Click the **List-Graph** tab. To highlight an individual group's data, select the group reporter's data on the left side of the screen, and their plotted data will turn blue on the screen. (If student names are not shown, select **View | Show Student Names.**) Discuss the similarities and differences among various groups' data, and what could cause them.

6. Reconfigure the activity to receive student equations. To do this, go to **Contribute** and select "Equations" from the pull-down menu. Click **Configure,** and the "Configure Calculators for Activity" window will appear. Under the **Main Settings,** choose 1 for "Number of equations per student." Check all three options for "Let students view graphs of equations," "Let students resubmit equations," and "Send current graph contents as background." Under the **Students Start with** section, select "Equations from calculator." Click **OK.** In the Activity Center, click the **Graph-Equation** tab.

7. Click **Start Activity.** Students will see their equation from Y1. Tell reporters to press SEND ([Y=]) to send in this equation.

Q1 Discuss the general direction of the line of best fit. Ask questions about the number of points above and below the line.

8. To check each individual group's data with their equations, click the **List-Graph** tab and highlight all the student data on the left side of the Activity Center and click the **Hide** button at the bottom of the screen (or press Ctrl-H). Then highlight one reporter's data and click the **Show** button (or press Ctrl-S). Click the **Graph-Equation** tab and have the same reporter's equation showing by doing a similar hiding/showing process.

Q2 As a class, discuss how well each group's equation fits their data. You may wish to have reporters resubmit their modified equations based on class input, or you can modify their equations by clicking on the particular equation and changing the rebound rate value.

For help with Quick Polls, see the Tip Sheet.

9. For Step 10 of the investigation, do a Quick Poll set to "Open Response" and have students enter their answers. Discuss differences.

10. For Step 11 of the investigation, do a Quick Poll set to "Open Response" and have students enter their answers. Discuss differences.

In the remaining steps, all students start with a given set of data and find a line of best fit. Groups' lines should be fairly similar, and you can discuss whether different lines are possible.

11. Select only one group's data to send to the whole class. To do this, delete all equations and delete all data except for that belonging to your chosen group.

Simply highlight all undesired data and equations and select **Edit | Delete,** and click **Yes** when asked if you are sure you want to delete the selection. Reconfigure the activity to receive lists. To do this, go to **Contribute** and select "Lists" from the pull-down menu. Click **Configure,** and the "Configure Calculators for Activity" window will appear. Under the **Students start with** section, select "Existing lists." Click **OK.** Click **Start Activity.** When the students have received the data, click **Stop Activity.**

12. Instruct students to exit NavNet and find an equation for the line of best fit. The group reporter will send in this equation, so group reporters will need to log back in. Reconfigure the Activity Center to receive equations again, as described in Steps 6 and 7.

Q3 Ask, "Do the lines follow the pattern of the points?"

Q4 Ask, "Are there an equal number of points above and below the line?"

Q5 Ask groups to use their model to predict the maximum load for beams made of 25 strands of spaghetti. To determine if groups got it correct, click the **Equation** tab. In the table of values on the right side of the screen, click the pull-down menu and select the equation(s) whose *y*-values you want to show. The *y*-values that correspond to the given *x*-values appear. The selected equations also appear in the blank table of values at the bottom of the screen. Enter 25 in the first row under "X." The corresponding *y*-value appears for each equation. You can use these values to allow students to check their answers.

In this activity, students follow steps similar to those in the investigation The Point-Slope Form for Linear Equations. TI-Navigator allows students to contribute equations in different forms and see that they all graph the same line. The activity concludes with several Quick Poll questions that help you evaluate student understanding.

Activity Time: 15–20 minutes. The first five steps of the activity can be teacher directed and take less time if needed.

PREREQUISITES AND MATERIALS

You will need the TI-Navigator activity file **4-3 Point Slope.act.** This activity file contains the data from the investigation.

Students should know how to find slope, graph equations on the calculator, set a graphing window, and use table-set and table functions on the calculator.

SETTING UP THE ACTIVITY

On the TI-Navigator teacher computer home screen, click the *Activity Center* icon. Choose **File | Load | Load Activity Settings** and load the activity settings file **4-3 Point Slope.act.**

Click the **Graph** tab within the Activity Center. Minimize the Activity Center while you do Steps 1–3 of this activity.

RUNNING THE ACTIVITY

For help logging in, see the Tip Sheet.

For help with Screen Captures, see the Tip Sheet.

To refresh Screen Captures, click **Refresh screens.**

1. Go to the TI-Navigator home screen and click the **Begin Class** button. Ask students to log in on their calculators and select 4: EXIT APP.
2. Have students work through The Point-Slope Form for Linear Equations investigation Steps 1–5. Assess progress by taking Screen Captures as they work.

Q1 As students work on Step 4, ask "What do you notice about the graphs of the two equations?" Refresh Screen Captures to check student work. Display them if needed for discussion.

Q2 As students work on Step 5, ask "What do you notice about the tables of the two equations?" Refresh Screen Captures to check student work. Display them if needed for discussion.

3. Ask students to return to NavNet. To do this, they press APPS, select NavNet, press ENTER (they will still be logged on), and select 1: ACTIVITY CENTER.

4. Enlarge the Activity Center window and click **Start Activity.** The investigation data will be sent to students, and will display in lists L1 and L2 on students' calculator screens. Click **Stop Activity.** (*Note:* It's okay if students press SEND before you stop the activity.)

Q3 Ask, "What does *x* represent?" [The time in seconds since the water began being heated.]

Q4 Ask, "What does *y* represent?" [The temperature of the water, in degrees Centigrade.]

5. Reconfigure the activity so that students will see the plots as well. To do this, click the **Configure** button. The "Configure Calculators for Activity" window will open. Under **Students start with,** select "Lists from calculator" and click **OK.** Click **Start Activity.** Students will again see L1 and L2, but they'll also see the option PLOT. To see a plot of the data, students press PLOT (ZOOM) and ENTER. They can move between lists and graph by pressing PLOT, LIST, and BACK. Click **Stop Activity.** (Again, if students send anything, it won't cause a problem.)

For help with Quick Polls, see the Tip Sheet.

6. Assign each group of students a pair of points from the data, repeating pairs if necessary. Ask students to calculate the slope between the two points, rounded to the nearest hundredth. Use a Quick Poll set to "Open Response" to collect answers. Note that the answers will not all be the same, but will be close.

Q5 Ask, "Why are the slopes between each pair of points not the same?" [Because the points don't exactly lie on a line.] "Why are the slopes pretty close?" [Because they *almost* lie on a line.]

7. Reconfigure the activity to receive student equations. To do this, go to **Contribute** at the left end of the tool bar and select "Equations" from the pull-down menu. Click the **Configure** button, and the "Configure Calculators for Activity" window will appear. In the **Main Settings** section, choose 1 for "Number of equations per student," and check options "Let students view graphs of equations" and "Send current graph contents as background." In the **Students Start with** section, select "Empty equations." Click **OK.** In the Activity Center, click the **Graph-Equation** tab.

8. Tell groups to write an equation in point-slope form that passes through their pair of points.

9. Click **Start Activity.** Students will receive a blank equation. Have them enter their equation and have *only one person* from each group press SEND to send their equation. Pressing PLOT will allow students to view a graph of their equation before sending.

10. Click **Stop Activity.** Compare groups' lines. The lines will be a little bit different from each other, because they are passing through different pairs of points, but because the data is fairly linear, all correct lines should be a good fit.

Ask a few questions to assess student understanding.

Q6 Ask, "Point-slope form can be used if you know two points on a line. What is the first step to finding the equation that goes through two points?" [Calculate the slope.]

Q7 Use Quick Polls set to "Open Response" to ask questions such as the following:

- What is the slope of $y = 2 + 5(x - 3)$? [5]
- What is one point on the line $y = 2 + 5(x - 3)$? [(3, 2). *Note:* If students enter a different point that is also on the line, discuss how these other points were found.]
- Write an equation in point-slope form for a line with slope -2 that passes through the point $(-3, 4)$. [$y = 4 - 2(x + 3)$]

In this activity, students start with a linear equation and create a series of equivalent equations, working toward an equation in intercept form. As students enter each equivalent equation, TI-Navigator graphs the equations. Each successive graph should overlay the previous one—if it doesn't, students know they've done something wrong.

This activity can be done before the Equivalent Equations investigation, to provide visual evidence that equivalent equations truly are equivalent—they produce the same graph.

Activity Time: 20–30 minutes

PREREQUISITES AND MATERIALS

You will need the TI-Navigator activity file **4-4 Equivalent.act.**

SETTING UP THE ACTIVITY

On the TI-Navigator teacher computer home screen, click the *Activity Center* icon. Choose **File | Load | Load Activity Settings** and load the activity settings file **4-4 Equivalent.act.**

Click the **Graph-Equation** tab within the Activity Center.

RUNNING THE ACTIVITY

1. On the TI-Navigator teacher computer home screen, click **Begin Class.** Ask students to log in on their calculators and go to the Activity Center.
2. On the teacher computer, return to the Activity Center and click **Start Activity.** Students will receive four empty equations: Y1, Y2, Y3 and Y4.
3. Tell students to enter the equation $y = 2(x - 3) + 4$ into Y1, and press SEND ([Y=]). A single line should be drawn in the Activity Center. If there are any extraneous lines, one or more students have entered the equation incorrectly. Ask students to check their equations. If they notice an error, they can correct the equation on their calculators and press SEND again. The old line will be replaced by a new one.

If you select **View | Show Student Names,** students' Display Names will show when you hold your cursor over a line. This may be helpful if extraneous lines appear.

4. Direct the class to enter equivalent equations into Y2 through Y4, one step at a time, working toward an equation in intercept form. Be sure they press SEND to send each equation. (*Note:* By pressing PLOT, they can see if their lines are equivalent before they send them.) Each equation should graph onto the previous one. Again, if extraneous lines appear, have students self-correct.

If students are getting out of synch, you can click **Pause Activity** between each step.

The successive equations should be: $Y2 = 2x - 6 + 4$ and $Y3 = 2x - 2$. (In some cases only three of the blank equations will be used.) Take advantage of the opportunity to discuss common mistakes that occur, and how they can be corrected.

5. Click **Stop Activity.** Highlight all equations on the right side of the screen and press **Delete** on your computer keyboard.

6. Repeat Steps 2–5 with several other equations. You might try the equations $y = -3(x + 1) - 4$, $y = \frac{2}{3}(6x + 3) - 5$, and $y = 4(-2x + 2) - (6x + 2)$.